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# ON THE RELATIONSHIP BETWEEN FINANCIAL MEASURES AND CONTRACTOR PRICING STRATEGY: EMPIRICAL TESTS IN THE DEFENSE AEROSPACE INDUSTRY

BY

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This report includes two separate but related empirical studies of the relationship between financial measures for defense aerospace contractors and pricing strategies adopted by contractors. Two pricing strategies are identified: skimming and penetration. Collectively the findings indicate that the adoption of a particular pricing strategy is associated with the financial condition of the contractor as reflected in measures of risk, asset utilization and organization slack.

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# ON THE RELATIONSHIP BETWEEN FINANCIAL MEASURES AND CONTRACTOR PRICING STRATEGY: EMPIRICAL STUDIES IN THE DEFENSE AEROSPACE INDUSTRY

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# PREFACE

This technical report includes two separate but related studies. Both studies provide empirical evidence of a relationship between financial measures for defense contractor firms and pricing strategies adopted by those firms. Both studies attempt to distinguish between "skimming" and "penetration" pricing approaches. Both studies use the same sample of firms within the defense aerospace industry.

The first study, "The Effect of Financial Condition on Product Pricing Strategy," tests for associations of measures of profitability, liquidity, capital structure, asset utilization and investment with pricing strategies. Results indicate that a small set of financial ratios can explain a substantial proportion of the difference in pricing strategies adopted across the sample of contractors.

The second study, "Organizational Slack and Risk Taking Behavior: Tests of Product Pricing Strategy," attempts to combine financial measures into a framework for reflecting the broader concept of organizational slack. Slack is hypothesized to motivate a more risky pricing strategy. Tests confirm the hypothesis.

Separate abstracts summarizing the two individual studies in more detail are presented immediately preceding each study.

# THE EFFECT OF FINANCIAL CONDITION ON PRODUCT PRICING STRATEGY

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# THE EFFECT OF FINANCIAL CONDITION ON PRODUCT PRICING STRATEGY

## Abstract

This study investigates the information content of financial ratios in the context of detecting pricing strategy for new products. The premise is that product pricing strategy is selected to serve corporate financial goals and may be predictable using financial measures publicly available prior to product introduction. Two pricing strategies are identified: skimming and penetration. The hypotheses are that firms with high profitability will skim to maintain high profit measures, that firms with high risk will skim to increase liquidity and minimize long run uncertainty, and that firms with low asset utilization will penetrate to increase activity. Using data from 35 new projects, the slopes of price reduction curves over time are calculated to reflect pricing strategy. Correlation and multiple regression tests are conducted to test the associations between price reduction slopes and financial ratios taken from the year prior to project initiation. Regression models including sets of financial ratios are able to explain over 50% of the variance in price reduction slopes. Findings suggest that pricing strategy is associated with risk and asset utilization, as reflected in financial ratios.

# THE EFFECT OF FINANCIAL CONDITION ON PRODUCT PRICING STRATEGY

## Background-Pricing Strategy

There are numerous ways to describe or categorize pricing strategies in general (see Small Business Report [1985]) but firms introducing new products or technology typically use one of two common product pricing approaches: penetration or skimming (Dean [1969], Wind [1982]). Discussed by many authors, the two strategies are widely understood and used by business practitioners. The skimming strategy calls for high initial prices followed by lower prices at later stages, while the penetration strategy calls for a low initial price with little or no price reduction over time.

The objective of the skimming strategy is to achieve the maximum profit in the shortest time by charging the highest price that the market will bear (James [1969]). Price reductions occur in a series of steps which are timed to provide as much profit as possible at each step. Thus the advantage of skimming is a more rapid return on investment. Firms adopting a skimming strategy must keep one step ahead of competitors; there is the risk that competitors may under-price and enter the market.

The objective of the penetration strategy is to develop wide product demand rapidly through a low initial price. Once the market has been captured, the firm can take advantage of either price increases or cost reductions to earn additional profits

(Dean [1969], James [1969]). The firm's established market position dampens the incentives of competitors to enter the market.

There are clear incentives for a firm to conceal its pricing strategy. If customers assume a firm is skimming, they may delay purchases to obtain a more favorable price later on. If competitors detect a skimming strategy, they may counter with a lower price and capture market share. If competitors detect a penetration strategy they will anticipate the lack of price reduction in the future and be more encouraged to enter the market. For these same reasons there are benefits to be gained by customers and competitors if pricing strategy can be predicted.

The premise of this paper is that pricing strategy will be influenced by financial condition, and that pricing strategy may be predictable using financial ratios publicly available prior to product introduction. The next section of the paper links financial condition to pricing strategy and lists the hypotheses to be tested. Later sections describe the sample, measurement of variables and statistical procedures used to test the hypotheses.

## Financial Condition and Pricing Strategy

Firms typically have the greatest freedom in choosing between the skimming and penetration strategies at the time of initial introduction of a new product (Wasson [1974]). Each of the two strategies can be described in terms of the relationship

between two variables: the price of the first unit sold and the rate of price reduction overtime. Skimmers exhibit a high first unit price and a steep price reduction curve, while penetrators exhibit a low first unit price and a flat price reduction curve. In principle the firm could be indifferent to the two strategies. A high initial price coupled with steep price reduction or a low initial price coupled with flatter price reduction could both result in the same present value for a product and the same net economic benefit. Neither strategy is inherently more profitable. In practice, however, there are likely both general external and firm-specific internal factors that will result in one strategy being preferred to the other.

External factors are related to the nature of the product's market and include such things as the degree of competition, price elasticity, market segmentation, the length of the product's life cycle, and customer familiarity with the product. While clearly important, these external factors are not of immediate concern here. (See Dean [1969], James [1969], Caferelli [1980], Wasson [1974] for further elaboration.)

Internal factors may be related to financial condition and reflected in the firm's financial ratios. Readers familiar with accounting or financial statement analysis are well aware that numerous ratios can be calculated from financial statement data and that these ratios can be categorized in various ways. It is not unreasonable however to categorize financial ratios into five broad categories representing five aspects of financial

condition:

1. Profitability (Return on Investment)
2. Short Term Liquidity
3. Solvency (Capital Structure)
4. Asset utilization (Activity or Turnover)
5. Capital investment

The object here is to suggest why pricing strategy may depend on these aspects of financial condition.

Profitability: As indicated above, neither skimming nor penetration is in the long run inherently more profitable; the central difference between the two is in the timing of profits. Skimming provides for high profit recognition immediately after product introduction, while penetration holds out the possibility of cost reductions or price increases and higher profits at a later stage. Since executives are frequently compensated on the basis of profit measures, one might expect sensitivity to the effect of pricing strategy on such measures to influence the choice of strategy. High profitability ratios ex ante (prior to the introduction of a new product) may be associated with continuing demand for high profit projects in the short run. Penetration, when compared to skimming, increases the probability that average return on investment measures will decline ex post and, ceteris paribus, does so more for firms with high profitability ex ante. Consequently, firms with high profitability are hypothesized to have a stronger preference for skimming.

Short term Liquidity: Initiation of new products may require substantial outlays to finance inventories, production volume and product introduction costs. Dean [1969] and James [1969] argue that skimming, because of the faster payback due to higher initial prices, is appropriate for firms with a need for funds in the short run. Ceteris paribus, firms with a poor short term liquidity position should have greater difficulty or a higher cost of raising funds externally and may prefer to generate funds rapidly through the product. Consequently, firms with poor liquidity are hypothesized to have a stronger preference for skimming.

Solvency: Solvency measures reflect the amount and type of debt in the firm's capital structure and indicate long term risk. Analogous to the reasoning presented above under liquidity, firms that are more highly leveraged should have a higher cost of raising new capital and may exhibit a preference for raising funds through the new project by skimming. In addition, the alternative pricing strategies differ with respect to long run risk. The penetration strategy requires that competition be discouraged and returns be earned over the long run to be successful. However skimming, by front-ending profit, reduces the risk associated with future uncertainty in the product's market (Dean [1969]). Firms with greater risk may prefer to reduce future uncertainty. For both these reasons, firms with poorer solvency measures (more highly leveraged) are hypothesized to prefer skimming.

Asset utilization: If a firm has limited manufacturing capacity, a small volume but highly profitable market approach (i.e., skimming) may be the most economic (James [1969]). Penetration requires wide diffusion of the product to be successful and consequently requires greater availability of capacity. Measures of activity or turnover reflect the level of sales generated on assets and consequently indicate the degree to which facilities, resources or capacity are being utilized. One would expect that firms that are fully using existing capacity may be constrained from following the higher volume penetration strategy, while firms not fully using existing capacity should prefer penetration to increase the probability that their capacity is put in service. Consequently, firms with low activity ratios are hypothesized to prefer penetration.

Capital investment: Somewhat analogously, investment in new assets may indicate future pricing strategy. Skimmers should have less requirement to expand capacity, while penetrators, expecting to generate volume through low initial price, have a greater need to expand. Major investment in capacity could signal a penetration strategy, and given an increase in new assets, penetration would be a preferable strategy to assure utilization of those assets. Consequently, firms with high ratios of new investment in plant and equipment, relative to existing assets or levels of activity, are hypothesized to prefer penetration.

To summarize the hypotheses: Firms that skim (as compared

to firms that penetrate) are expected to exhibit measures of high profitability, poor liquidity, poor solvency, high asset utilization and low capital investment, prior to new product introduction.

Slope of the Price Reduction Curve

As indicated before, the two strategies can be described in terms of the relationship between first unit price and the subsequent price reduction curve. Learning curves can be used to distinguish the two strategies. Learning curve theory (Womer [1979], Kaplan [1982]) describes the decline in per unit production costs a manufacturer incurs with increasing volume. The learning curve concept originated from the observation that individuals performing repetitive tasks tend to exhibit a rate of improvement, but there are many reasons for reduction of costs over repetitive operations: more efficient labor, less material from reduced scrap and waste, and higher productivity from improved processes. Thus a learning curve can more generally be referred to as a cost reduction curve. A per unit reduction can be extended conceptually to the measure of price per unit. Thus learning curves can also be used to represent price reduction curves.

The learning curve function relates a dependent variable (price) with an independent variable (volume) as follows:

$$P=AX^{B}$$

or in log form:

$$\ln P = \ln A + B (\ln X)$$

Where P is the price of the Xth unit produced and A is the price of the first unit. If prices are level as volume (X) increases, then the exponent B is zero. B is negative when prices decline with volume. The slope of the learning curve, S, is related to B as follows:

$$B = \frac{\ln S}{\ln 2}$$

A slope of 1.00 implies a horizontal line - i.e., no price reduction. The lower the decimal value of the slope, the higher the price reduction rate. For example, .800 is a steeper (faster) price reduction rate than .900.

The slopes of learning curves fit to actual prices are used in this study to reflect pricing strategy. Relatively high values for S are consistent with penetration (flat slope), while lower values are consistent with skimming (steeper reduction).

Sample and Data

The products whose price reduction curves are examined in this study consist of major military weapons systems (aircraft and missiles) acquired by the Department of Defense from 1951-1980. Two publications, U.S. Military Aircraft Cost Handbook (Depuy, et al. [1983]) and U.S. Military Missile Cost Handbook (Crawford, et al. [1984]), provide a wealth of data on per unit costs, volume and cost patterns for most major U.S. aircraft or missile systems. (Note: costs for the government are prices to the supplier.) Price reduction slopes using learning curves

(using constant dollars) are also included. The handbooks provide data for numerous weapon system programs but programs had to pass three filters to be included in the study. First, programs had to run at least three years in order for meaningful slopes to be calculated. Second, programs where learning curves fit to the raw price data provided a poor "fit" were eliminated. Since the purpose here is to explain variations in price-reduction curves, only programs with well-defined price reduction slopes were included. Operationally, an $R^2$ value in excess of .6 was used as a cutoff for inclusion. Third, financial statement data for the year prior to program initiation had to be available without unreasonable search.

The resulting sample consisted of 35 programs. Project identifiers, the producer, the year of project initiation and price reduction slopes for the 35 programs are provided in table 1. Slopes around .800 to .900 are common for complex, high-technology products, although more extreme values are not rare (Greer [1985]), so the sample firms seem to be representative of the product type.

Clearly defense systems are of a specialized nature and not typical of products in general. The market is unusual, with a monopsonistic buyer and an oligopolistic seller. Yet varying incentives exist for both skimming and penetration within this market. Sellers that skim risk program termination or curtailment due to excessive price, and risk competitor entry by encouraging the government to seek lower prices elsewhere (second

sourcing). Sellers that penetrate risk program termination before long run profits can be realized.

There are some benefits from focusing on defense systems. Since the customer is a constant across the sample products, some element of control over external factors relating to customer and market is achieved. Similarly, since all firms in the sample are in the same defense aerospace industry, control over industry differences in financial ratios is achieved.

Financial Ratios and Correlation Analysis

In general, the object of the analysis was to determine if financial ratios could explain variation in price-reduction slopes in a manner consist with the previously hypothesized relationships.

Twenty-four financial ratios, several within each of the five identified categories, were computed for each program for the year prior to program start. Each ratio and its formula are provided in table 2. In general the ratios used are closely related to ones commonly found in Accounting and Financial Statement Analysis text books, but a few require comment. Ratio 12, the Equity to Debt ratio was used rather than the more traditional Debt to Equity ratio because some sample firms had negative equity. For the Investment ratios (21-24), new investment in plant and equipment (P&E) was calculated as $P\&E_t + \text{Depreciation}_t - P\&E_{t-1}$. This provides only an approximation of new investment but was necessary because detailed Statement of

Changes in Financial Position data was unavailable for many firms, particularly those from earlier years. Each of the four investment ratios is an attempt to deflate investment for some aspect of firm size.

Each of the individual ratios was correlated with price reduction slopes. Expected signs, Pearson correlation coefficients and significance levels are reported in the right hand columns of table 2. (Spearman non-parametric correlations provided substantially the same results). Two findings are of note: First, virtually all of the univariate correlations are insignificant. The null hypothesis of no association can be rejected for only three ratios (return on equity, current debt ratio, investment to funds) at even a liberal .11 alpha level. Second, in spite of general insignificance, the signs of the associations are as hypothesized for all but six of the ratios. All ratios within the activity and investment categories have the expected sign. All five ratios with wrong signs have correlations less than .2, while all ratios with correlations in excess of .2 (eight) have the correct sign. Some of the wrong signs are perhaps understandable. For example, a negative correlation was hypothesized for profitability ratios and a positive correlation for interest coverage ratios. Yet negative signs are observed for both. One would expect, ceteris paribus, that firms with high profitability are also more likely to have high interest coverage. Consequently, in these univariate tests, the profitability aspect may dominate causing the negative signs

for interest coverage.

This effect suggest that univariate tests may be inappropriate and that controlling for the inherent interrelationships between individual ratios with a multivariate design may be helpful.

Regression Models

Stepwise multiple regression was used to create models including several ratios jointly explaining the variance in slopes. By selectively influencing the entry of variables into the model during the stepwise procedure, the researcher has considerable control over the model that results. Various models were investigated in a heuristic and iterative fashion. Three qualitative factors were of concern in constructing the models:

1. Parsimony: A model with few ratios was preferred
2. Multicollinearity: Low pairwise correlations between ratios and low collinearity across the set of ratios in a given model was desired.
3. Meaningful signs and lack of redundancy: Some of the ratios in the study are just different measures of the same construct. For example return on total assets and return on equity are both profitability measures. Both were selected in some models, with opposite signs. This suggests that what is explaining the variance in slope is not the profitability measures but difference in their

construction (i.e., different denominators) and some other factor (e.g. leverage) is what's important. Attempts were made to eliminate obvious redundancies and interactions of this nature.

Three statistical criteria were used to evaluate models.

1. F value and its significance;
2. Significance of t statistics for individual coefficients;
3. Adjusted $R^2$ (unadjusted $R^2$ necessarily increases as more ratios are added to a model.)

Table 3 lists the best three, four, five and six ratio models developed in line with the above qualitative factors and statistical criteria. Looking at the table, several items are of note: Regardless of the number of ratios included in the models, the same relatively small subset of ratios are important. All the models have significant F values at .004 or lower. Individual coefficients tend to be significant at traditional levels for the three and four ratio models (A, B, and C) but deteriorate somewhat as additional ratios are included (D, E, and F). Looking at adjusted $R^2$ values, there is a material increase in variance explained when a fourth ratio is included, but only marginal increases with the inclusion of additional ratios. (Adjusted $R^2$ falls when more than six ratios are included.)

While models B and C are perhaps "best" in terms of the criteria previously outlined (parsimony, high $R^2$, significant F and t values), model F has the highest $R^2$ and includes all of the

ratios that tended to be important predictors. Consequently it is best to focus on model F for discussion purposes. All six of the ratios in model F appear with the hypothesized sign. A factor analysis was conducted on the full set of ratios and, except for some overlap between the current ratio and the current debt ratio, each of the ratios in the model is associated with a distinct individual factor. Consequently, it is fair to infer that several different aspects of financial condition are captured by the model. Four of the five ratio categories identified earlier (table 2) are represented in the model. Only the profitability category is missing.

The ratios included in the model seem to emphasize "current" rather than long-run aspects of financial condition: Two liquidity ratios were important (Current Ratio and Receivables Turnover), while one solvency measure (Current Debt Ratio) involves current liabilities, and the activity measure (Inventory Turnover) relates sales to a current asset. However, models replacing the Current Debt Ratio with the Debt Ratio (ratio # 11) and the Inventory Turnover ratio with the Asset Turnover ratio (# 17) were still significant and had adjusted $R^2$ values above .40.

## Discussion and Conclusions

The models presented in this paper demonstrate that pricing strategy is significantly associated with financial condition and suggest that financial ratios available prior to product introduction may be useful in predicting pricing strategy. A relatively small set of ratios explained over half of the

variance in price-reduction rate. The most important ratios were ones reflecting aspects of risk (liquidity and solvency) and capital utilization (activity and investment). For these aspects of financial condition, the hypotheses were supported. Firms with higher risk immediately prior to product introduction tended to prefer the skimming strategy. Firms that had engaged in major investment in new assets or were poorly utilizing existing assets prior to product introduction tended to prefer penetration.

Profitability ratios were not found to be significantly related to pricing strategy after controlling for ratios from other categories. Given the nature of the sample, government contractors, this is perhaps not surprising. Interviews with major defense contractors (Defense Financial and Investment Review [1985]) reveal that contrators tend to have the following goals:

- To reduce short term risk from cyclic market activity through investment in diversified activities
- To properly employ financial and equity leverage
- To achieve operating effectiveness and efficiency
- To effectively manage production, resources and capital to achieve an adequate return on investment.

Defense contractors have been characterized as risk adverse, profit satisfiers rather than profit maximizers (Kennedy, [1983,1985]). The presence of risk and capital utilization ratios in the model, and the absence of profitability ratios, are consistent with the goals and character of defense contractors.

Perhaps studies involving firms from a different industry would reveal profitability as an important variable.

There are some obvious limitations to the study. Sample size is small. The industry and product market investigated are not typical of industries and markets in general. Although numerous ratios were included, they do not exhaust the possible measures that can be calculated from publicly available financial information. Measures of changes in ratios from period to period prior to product introduction may be of interest. Lastly, the models presented in the paper are at this stage only descriptive. Their predictive ability to firms outside of the sample on which they were developed has not been established. In spite of the limitations, the findings do indicate that financial condition influences pricing strategy. Each of the limitations offers an opportunity for future research.

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TABLE 1

SAMPLE PROJECTS

| Project | Company | Year | Slope |
|---|---|---|---|
| F-86D | North American | 51 | .926 |
| F-89D | Northrup | 51 | .885 |
| F-86F | North American | 51 | .870 |
| F-84F | Republic | 51 | .725 |
| F-100A/C | North American | 52 | .839 |
| F-1B/C/MF-1C | North American | 52 | .783 |
| F-102-A | General Dynamics | 53 | .724 |
| F 101-A/B/C | McDonnell Douglas | 54 | .802 |
| F-100D | North American | 54 | .934 |
| A-4B | McDonnell Douglas | 55 | .834 |
| B-52G | Boeing | 57 | .869 |
| F-106A/B | General Dynamics | 57 | .837 |
| A-4C | McDonnell Douglas | 57 | .894 |
| F-105B/D | Republic | 57 | .759 |
| F-4A/B | McDonnell Douglas | 59 | .834 |
| P-3A | Lockheed | 60 | .718 |
| A-6A | Gruman | 61 | .829 |
| RIM-24B | General Dynamics | 61 | .923 |
| A-4E | McDonnell Douglas | 61 | .892 |
| RIM-2E | General Dynamics | 61 | .930 |
| F-4D | McDonnell Douglas | 64 | .886 |
| A-7A/B | Vought | 65 | .852 |
| P-3B | Lockheed | 65 | .910 |
| RIM-66A | General Dynamics | 66 | .763 |
| RIM-67A | General Dynamics | 66 | .825 |
| AIM-7F | Raytheon | 68 | .773 |
| A-7D | Vought | 68 | .950 |
| S-3A | Lockheed | 72 | .846 |
| F-15A | McDonnell Douglas | 73 | .917 |
| AGM-78D | General Dynamics | 73 | 1.088 |
| AH-1S | Bell | 75 | .891 |
| AH-1T | Bell | 76 | 1.021 |
| F/A-18A | McDonnell Douglas | 79 | .860 |
| AIM-7M | Raytheon | 80 | .880 |
| BGM-109 | General Dynamics | 80 | .943 |

TABLE 2

LIST OF RATIOS

| CATEGORY<br>Ratio Name | Calculation | Hypothesized Association with Slope | Correlation with Slope | Significance Level |
|---|---|---|---|---|
| **PROFITABILITY** | | | | |
| 1. Return on Assets | Net Income/Total Assets | - | -.20 | .26 |
| 2. Return on Equity | Net Income/Stockholders Equity | - | -.27 | .11 |
| 3. Return on Capital | Net Income/Non-Curr Liab + Stockholders Equity | - | -.22 | .22 |
| 4. Profit Margin | Net Income/Sales | - | -.13 | .47 |
| 5. Gross Margin | Gross Margin/Sales | - | .08 | .65 |
| **LIQUIDITY** | | | | |
| 6. Current Ratio | Curr. Assets/Curr Liab. | + | .25 | .16 |
| 7. Quick Ratio | (Cash + Mkt. Sec. + Acct. Rec.)/Curr.Liab. | + | -.03 | .87 |
| 8. Current Asset Ratio | Curr. Assets/Total Assets | + | -.16 | .35 |
| 9. Working Capital Ratio | (Curr Assets-Curr.Liab.)/Total Assets | + | .12 | .48 |
| 10. Receivables Turnover | Sales/Accounts Receivable | + | .17 | .33 |
| **SOLVENCY** | | | | |
| 11. Debt Ratio | Total Liab./Total Assets | - | -.08 | .64 |
| 12. Equity to Debt | Stockholders Equity/Total Liabilities | + | .11 | .55 |
| 13. Curr. Debt Ratio | Curr.Liab./Total Assets | - | -.29 | .10 |
| 14. Non-Curr. Debt Ratio | Non-Curr. Liab/Total Assets | - | .18 | .30 |
| 15. Interest Coverage(N) | Net Income + Int. Exp/Interest Expense | + | -.11 | .56 |
| 16. Interest Coverage(O) | Operating Income/Interest Expense | + | -.04 | .83 |
| **ACTIVITY** | | | | |
| 17. Asset Turnover | Sales/Total Assets | - | -.23 | .19 |
| 18. Plant Asset Turnover | Sales/Plant Equipment | - | -.03 | .87 |
| 19. Inventory Turnover | Cost of Goods Sold/Inventory | - | -.05 | .78 |
| 20. Working Capital Turnover | Sales/(Curr.Assets-Curr. Liab) | - | -.19 | .29 |
| **INVESTMENT** | | | | |
| 21. Investment to Sales | Investment/Sales | + | .25 | .21 |
| 22. Investment to Funds | Investment/(Net Income + Depreciation) | + | .41 | .04 |
| 23. Investment to Assets | Investment/Total Assets | + | .08 | .69 |
| 24. Investment to Plant | Investment/Plant & Equipment | + | .01 | .95 |

TABLE 3

REGRESSION MODELS

| MODEL | NUMBER OF RATIOS | INTERCEPT | LIQUIDITY | | SOLVENCY | | ACTIVITY | INVESTMENT | F | | $R^2$ | ADJ. $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CURRENT RATIO | RECEIVABLE TURNOVER | CURRENT DEBT RATIOS | INTEREST COVERAGE(O) | INVENTORY TURNOVER | INVESTMENT TO FUNDS | | | | |
| A | 3 | 1.0478 | NA | NA | -.3612[a] | NA | -.0110 | .0847 | 6.76 | .0027 | .516 | .440 |
| | | | | | .1365[b] | | .0040 | .0348 | | | | |
| | | | | | .0159[c] | | .0134 | .0251 | | | | |
| B | 4 | 1.0590 | NA | NA | -.4812 | .0007 | -.0100 | .1050 | 6.81 | .0016 | .602 | .514 |
| | | | | | .1410 | .0003 | .0038 | .0340 | | | | |
| | | | | | .0031 | .0643 | .0175 | .0064 | | | | |
| C | 4 | .4668 | .0993 | .0112 | NA | .0006 | NA | .1542 | 7.22 | .0012 | .616 | .531 |
| | | | .0239 | .0034 | | .0003 | | .0357 | | | | |
| | | | .0006 | .0047 | | .0840 | | .0004 | | | | |
| D | 5 | .6458 | .0654 | .0103 | -.2448 | .0007 | NA | .1492 | 6.03 | .0022 | .639 | .533 |
| | | | .0402 | .0035 | .2335 | .0003 | | .0358 | | | | |
| | | | .1219 | .0097 | .3092 | .0518 | | .0007 | | | | |
| E | 5 | .9957 | NA | .0051 | -.5133 | .0007 | -.0071 | .1182 | 6.06 | .0021 | .640 | .535 |
| | | | | .0038 | .1399 | .0003 | .0043 | .0347 | | | | |
| | | | | .1959 | .0019 | .0517 | .1179 | .0034 | | | | |
| F | 6 | .7745 | .0469 | .0075 | -.3042 | .0007 | -.0051 | .1350 | 5.29 | .0035 | .665 | .539 |
| | | | .0433 | .0044 | .2382 | .0003 | .0046 | .0379 | | | | |
| | | | .2951 | .1065 | .2197 | .0649 | .2846 | .0026 | | | | |

[a] Coefficient
[b] Standard Error
[c] Significance level

# ORGANIZATIONAL SLACK AND RISK TAKING BEHAVIOR: TESTS OF PRODUCT PRICING STRATEGY

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# ORGANIZATIONAL SLACK AND RISK TAKING BEHAVIOR: TESTS OF PRODUCT PRICING STRATEGY


## Abstract

This paper tests the relationship between organizational slack and risk taking in organizational decision making. Product pricing strategies are identified and characterized with respect to risk. Organizational slack is measured using various financial variables. Results indicate that firms which have increases in organizational slack prior to the introduction of new product are more likely to adopt a higher risk product pricing strategy. Implications regarding the measurement of slack using financial variables are also discussed.

ORGANIZATIONAL SLACK AND RISK TAKING BEHAVIOR:
TESTS OF PRODUCT PRICING STRATEGY

Traditional theories in economics and finance argue that individuals and organizations are risk adverse and that higher risk projects or strategies will be undertaken only if there is a commensurate higher expected return. While such theories based on risk aversion don't imply that there is a causal relationship between firm performance and risk taking behavior, they do suggest that over the long run a positive association between risk and return should be exhibited. However, studies of the within-industry relationship between risk and return for several industries indicate that the observed relationship is most often negative (Bowman, 1980; Treacy,1980). Bowman (1982) termed this result the "risk-return paradox" and hypothesized that it was caused by poorer performing firms adopting higher risk decisions.

An inverse relationship between performance and risk taking has been addressed by various authors (Cyert & March, 1963; March 1981; March and Shapira, 1982) and can perhaps be explained in terms of a satisficing level of firm performance (March & Simon, 1958; Simon 1976). Simply put, firms performing above their satisficing level may prefer a low risk (low variance) decision because it reduces the probability that subsequent performance will fall below the satisficing level, while firms performing below their satisficing level may prefer a high risk (high variance) decision because it increases the probability that subsequent performance will fall above the satisficing level.

Singh (1983) cited evidence both supporting and rejecting the hypothesis that poor performance motivates increased risk taking and argued that the contradictory empirical findings occur because performance and risk taking are linked in a complex manner. He posited two conceptually distinct processes that link performance and risk taking. In his model, good performance has a negative

direct impact on risk taking because of the role of the satisficing level, mentioned above. On the other hand, there is also an indirect impact mediated by organizational slack. First, good performance increases organizational slack (Cyert & March, 1963); then increased slack provides the opportunity for increased risk taking. The positive relationship between slack and risk taking rests on the idea that the presence of slack reduces the criteria by which actions are considered acceptable (Cyert & March, 1963), allows the organization to experiment and innovate (Hambrick & Snow, 1977) and permits the firm to act more boldly (Bourgeois, 1981).

Testing his model on a sample of 54 firms, Singh found tentative support for both processes; measures of performance were negatively associated with some measures of risk, but performance was also positively associated with slack, which was positively associated with risk.

This paper focuses on the link between organizational slack and risk taking and presents tests of the hypothesis that increases in slack are followed by more risky strategic decisions. While this paper addresses the same issue raised by Singh (slack and risk taking) there are several differences between the approaches used. Singh tested for associations between slack and global measures of risk (developed from a questionnaire and from financial measures). This study instead isolates a specific strategic decision, characterizes alternatives in terms of risk, and tests for associations between slack and the alternative adopted. In short, the focus is on an identifiable action. Singh tested for <u>contemporaneous</u> associations between slack and risk measures. This study investigates the association between changes in slack and <u>subsequent</u> risk-taking behavior. It may be more defensible to argue for a cause-effect association when the potential effect (risk taking) is observed a point in time following the

presumed cause (slack). In addition, this study incorporates a wider set of measures to reflect slack.

The perspective of the paper is that slack is a variable that influences the strategic behavior of the organization. That perspective is consistent with previous studies linking slack with other strategic behaviors such as innovation (Hambrick & Snow, 1977; Mohr, 1969; Rosner, 1965,1968), research and development (Kay, 1979) and political behavior (Bourgeois, 1981; Bourgeois & Singh,1982).

The specific decision investigated in the study is pricing strategy for new products. Alternative pricing strategies and their riskiness are discussed in the next section. The measurement of organizational slack rests on recent studies using publicly available financial accounting data. Slack measurement and sample considerations are discussed in the METHODS section. The ANALYSIS section describes empirical tests and provides evidence in support of a positive relationship between slack and risk taking. The DISCUSSION section comments on the meaning of the results and, in particular, discusses some implications concerning the use financial accounting data to measure slack.

## PRICING STRATEGIES

There are numerous ways to describe or categorize pricing strategies in general (see Albaum, 1975; "The Pricing Decision", 1985) but firms introducing new products or technology typically use one of two broad product pricing approaches: penetration or skimming. Discussed by many authors (e.g., Caferelli, 1980; Dean, 1969; James, 1969; Wind, 1982) the two strategies are widely understood and used by business practitioners. The skimming strategy calls for high initial prices followed by lower prices at later stages, while the penetration strategy calls for a low initial price with little or no price

reduction over time.

The objective of the skimming strategy is to achieve the maximum profit in the shortest time by charging the highest price that the market will bear. Price reductions occur in a series of steps which are timed to provide as much profit as possible at each step. Thus one advantage of skimming is a more rapid return on investment.

In contrast, the objective of the penetration strategy is to develop wide product demand rapidly through a low initial price. Once the market has been captured, the firm can take advantage of either price increases or cost reductions to earn additional profits. The firm's established market position dampens the incentives of competitors to enter the market.

Pricing Strategy and Risk

Each of the two strategies can be described in terms of the relationship between two variables: the price of the first unit sold and the rate of price reduction over time. Skimmers exhibit a high first unit price and a steep price reduction curve, while penetrators exhibit a low first unit price and a flat price reduction curve. Neither strategy is inherently more profitable and both are observed in practice.

The two strategies do differ in the timing of profits and in riskiness. The consensus opinion is that skimming is less risky: With a high initial price, skimming maximizes short-term returns and provides a more rapid recovery of funds to finance the costs of product introduction and future expansion (James,1969). By front-ending profit, skimming reduces the risk associated with uncertainty in the product's market (Dean, 1969). Skimming allows for greater flexibility; it is typically easier to introduce a product with a high price and then reduce the

price as knowledge of the market and product demand is gained than it is to introduce at a low price and increase price later to cover unexpected costs or exploit product popularity (Dean, 1969).

Penetration is a more risky strategy. It assumes there is untapped market potential. It requires greater commitment of productive capacity. It assumes low competition from other manufacturers. "Attempting to take a sizeable (market) share through lower price is risky and often requires a heavy and long commitment of financial resources. Since the stakes and risks are high, the potential rewards must be substantial" (Caferelli, 1980: 176). "High rewards are possible with this strategy but only if economies of scale occur as predicted. Therefore, it is often a high risk strategy as well, since the potential exists for disastrous losses if costs fail to decline as rapidly as expected. Production problems or unrealized sales volumes can also undermine this strategy" ("The Pricing Decision", 1985: 77).

The general hypothesis of this paper is that organizational slack is associated with risk taking. Using pricing policy as a strategic decision and assuming penetration is the more risky pricing approach, a positive association between slack and adoption of the penetration strategy is hypothesized.

## METHODS

### Slope of the Price Reduction Curve

As indicated before, the two strategies can be described in terms of the relationship between first unit price and the subsequent price reduction curve. Learning curves can be used to distinguish the two strategies.[1] The learning curve function relates price with volume as follows:

$$P=AX^{B}$$

Where P is the price of the Xth unit produced and A is the price of the first unit. If prices are level as volume (X) increases, then the exponent B is zero. The slope of the learning curve (S) is related to B as follows:

$$B = \frac{\ln S}{\ln 2}$$

A slope of 1.00 implies a horizontal line (i.e., no price reduction). The lower the decimal value of the slope, the higher the price reduction rate.

In this study, slopes of learning curves fit to actual prices were used to reflect pricing strategy. Relatively high values for S (flat slope) are consistent with penetration, while lower values (steeper reduction) are consistent with skimming.

Sample

Pricing strategies for a sample of defense contractors manufacturing major aerospace weapon systems (aircraft and missiles) for the Department of Defense were examined in this study. Clearly defense contracting, particularly for major weapons systems, is specialized in nature.[2] Both the products and market are not typical of products and markets in general. Defense contractors were selected for investigation for four reasons.

1. Product Type. Major weapon systems are large dollar items which may represent a substantial segment of a manufacturer's business. Pricing strategy for such items is likely to be an important strategic decision. Furthermore, major weapon systems incorporate substantial innovation in design. Products involving significant innovation provide the greatest leeway in choosing a pricing strategy (Wasson, 1974).

2. Contractor Strategy and Risk. There are distinct differences in risk between penetration and skimming strategies in the defense contracting area.[3]

Defense contractors that penetrate, that have "bought-in" to a contract with a low price, risk program termination before long run profits can be realized. Given the uncertainties of the Federal budget process (because program funding is approved on an annual basis) and the uncertainties of product acceptance (because the capability of new weapons systems can not always be assessed in advance), program curtailment is a real possibility. Given the uncertainties of production costs (because of the state-of-the-art technology involved), failure to realize higher future profits through significant cost reductions is also a risk.

Skimming is the less risky strategy. Defense contractors that skim may risk program termination or curtailment due to excessive price, and may risk competitor entry by encouraging the government to seek lower prices elsewhere (termed "second sourcing"). But these risks are minimal. The high start up costs associated with the manufacture of major weapons systems typically make second sourcing an unattractive alternative for the government, and the flexibility afforded by the high initial price permits the skimmer to respond to termination threats with a price reduction.

3. Control. There are some methodological benefits gained from focusing on the defense industry. In general, the nature of the customer, the product market, and competitors can be expected to influence the choice of pricing strategy.[4] Since the buyer, the Department of Defense, is a constant across the sample, some control over customer type and product market is achieved. Similarly, since all sample firms are in the same defense aerospace industry, some control over the nature of the competition and industry differences in financial measures is also achieved.

4. Data availability. To examine pricing strategy, detailed pricing history data must be available. Two publication, U.S. Military Aircraft Cost

Handbook (DePuy, et al., 1983) and U.S. Military Missile Cost Handbook (Crawford, et al., 1984), provide a wealth of data on per unit prices (in both actual and constant dollars) and volume for most major U.S. aircraft or missile systems. Price reduction slopes were determined by fitting learning curves to the constant dollar price data for individual weapons system programs.

Programs had to pass three filters to be included in the sample. First, programs had to run at least three years in order to calculate meaningful slopes. Second, programs where learning curves fit to the raw price data provided a poor "fit" were eliminated. Since the objective was to use price-reduction curves to reflect pricing strategy, only programs with well-defined price reduction slopes were included. An $R^2$ value in excess of .6 was used as a cutoff for program inclusion. Third, financial statement data for two years prior to program initiation had to be available without unreasonable search.

The surviving sample consisted of 34 programs. The project identifier, the manufacturer, the year of program initiation and the price reduction slope for each of the 34 programs are provided in table 1. Slopes around .800 to .900 are common for complex, high-technology products, although more extreme values do occur (Greer, 1985), so the sample seem to be representative of the product type.

**INSERT TABLE 1**

The Measurement of Organizational Slack

The concept of slack is widely used in the organizational theory and business strategy literatures, but there is no single consensus definition.[5] However, most definitions suggest the idea of "excess", "spare", "surplus", "extra", "uncommitted", or "available" resources that provide "buffers", "cushions" or "opportunities". Slack thus involves excess resources rather than

just total resources. Because excess resources are difficult to identify, operationalizing measures of slack for empirical purposes has proved problematic and approaches have varied widely. Individual accounting-based measures, such as the level of expenditures (Mohr, 1969), operating expenses (Wolf 1971), return on investment (Litschert & Bonham, 1978; Odell, 1972), profit (Dimick & Murray, 1978), and sales (Litschert & Bonham, 1978) have been most frequently employed. Each of these individual measures uses a rather narrow aspect of a firm's condition as a proxy for the broader excess resources concept implied by slack.

Recent research by Bourgeois and Singh has developed a composite set of measures, based on publicly available financial accounting data, to capture slack. Originally, Bourgeois (1981) identified two sources of slack:

Internal: Slack created by managerial actions

External: Slack made available by the environment

Singh (1983) broke down internal slack into two components:

Unabsorbed: Excess liquid resources

Absorbed: Excess costs of various organizational activities

In a combined framework, Bourgeois and Singh (1982) offered a three category formulation of the dimensions of slack which rests on the idea of "ease-of-recovery":

Available slack: Resources not yet assimilated into the technical design of the organi- zation (e.g. excess liquidity).

Recoverable slack: Resources that have been absorbed into the system as excess costs, but may be recovered (e.g. excess overhead costs).

Potential slack: The capacity of the organization to generate extra resources from the environment (e.g. ability to raise capital).

Bourgeois and Singh (1982) provided several accounting based measures within each category. The specific measures used in this study follow their framework (with minor modifications noted below) and are outlined in Table 2.

**INSERT TABLE 2**

Some comment on the individual measures is perhaps necessary. Bourgeois (1981) said that the extent to which resources generated by profits are distributed as dividends or retained is a matter of managerial policy and provides a source of slack. He suggested that "net income minus dividends" or the "change in retained earnings" are appropriate measures of slack from this source. Neither dividend nor retained earnings data was available for the sample. Two measures, PROFIT and EQUITY, are designed to approximate his measures using data that was available.

WKCAP measures the net resources the organization has tied up in current or operating assets, relative to the level of activity. Ceteris paribus, large stores of current resources (e,g. cash, receivables, inventories) should be an indication of slack. Relying on the "ease-of-recovery" idea, Bourgeios and Singh (1982) decomposed WKCAP into three separate measures: QUICK, ACCTREC and INVENT. All four measures, then, are conceptually related and all capture aspects of the level of current resources relative to activity.

NCASSET extends the concept of resources relative to the activity level to non-current assets. Non-current assets reflect capacity and, when deflated by sales, may capture excess capacity. (Bourgeois, (1981) discussed excess capacity as an indicator of slack, but measures related to plant, equipment and other non-

current assets were omitted in the Bourgeois and Singh framework. Additional measures using Plant and Equipment/Sales and Total Assets/Sales were also employed in the analysis with results similar to NCASSET).

GENEXP measures the level of selling and administrative expenses relative to activity and captures the idea that slack is absorbed in various period costs such as salaries or overhead.

CURRDEBT, LTDEBT and TOTDEBT are all measures of capital structure and are designed to reflect the difficulty or cost of generating additional resources from the environment by short or long term financing. (Analogous measures scaled by sales or total asset provided similar findings). INTCOV is a traditional measure of the degree to which operations provides sufficient resources to service debt and should also reflect the ease of generating additional resources externally.

Some comments on the variables collectively are also necessary. As absolute measures of slack they only have meaning if some assumptions hold. If it is assumed (1) that there is some constant "necessary" level for each of the measures when operations are "normal", (2) that deviations from the necessary levels indicate slack, and (3) that firms in the same industry have the same necessary level, then cross-sectional differences in the variables (for firms in the same industry) would imply cross-sectional differences in slack. Although previous research has adopted these assumptions when measuring slack (Singh, 1983), they are perhaps strong assumptions in the current study because the observations while taken from the same industry, range over a 30 year period during which industry averages for the measures may have changed.

The measures are more meaningful when used to reflect changes in slack over time. It is more defensible to argue that there is some necessary level of a

given measure for the "normal" operations of a particular firm. Then changes in the measures would reflect changes in slack for the particular firm. This is not unreasonable since the individual measures are adjusted for the level of activity (generally, by deflating by sales). Take for example WKCAP. Analysts usually project working capital needs as a constant percentage of sales (Bourgeois, 1981). If working capital increases at a faster rate than sales (i.e. an increase in WKCAP over time) then it is not unreasonable to assume that there is an increase in liquidity in excess that necessary to support the increase in activity (i.e. an increase in slack). Bourgeios and Singh indicated that their measures are most appropriate when used to reflect changes in slack over time.

There are also theoretical reasons to focus on changes in slack. Theories linking strategic behavior to slack tend to see behavior as a reaction to increases or decreases in slack rather than its absence or presence ( Bourgeois, 1981; Kay, 1979; Thompson, 1969).

With these comments in mind, tests using both absolute and change measures were conducted.

## ANALYSIS

The purpose of the analysis was to test the relationship between slack and pricing strategy. Operationally this implied testing associations between price reduction slopes and measures of slack or change in slack. The analysis proceeded in several stages.

### Amount of Slack

Each of the slack variables was measured one year prior to the delivery of the first unit of product. Person correlations between each variable and price reduction slopes were computed. (Non-parametric Spearman correlation were also

computed for all correlation tests in the study. Findings were unchanged.) Correlation results are provided in Table 3. Recall that greater slack is hypothesized to be associated with the higher risk penetration strategy, so higher measures of slack should be associated with higher price reduction slopes. Correlation coefficients are generally low and insignificant and only seven of the twelve variables have the correct sign. However, the two significant variables, INVENT and NCASSET, do have the predicted sign. Relative to the other slack measures, INVENT and NCASSET reflect resources that are tied up in relatively less liquid form. Perhaps the amount slack capacity motivates risk taking.

**INSERT TABLE 3**

Slack Gainers and Slack Losers

To investigate changes in slack, the slack variables were calculated at two years prior to product introduction and compared to the measures at one year prior. Using each variable individually, firms were divided into "slack gainers" and "slack losers" depending on the directional change in the measure. T-tests for group differences in slope are contained in table 4. Results here are also mixed. Eight of the twelve tests exhibit the predicted sign for t. Significant results are found for slack change as measured by changes in WKCAP, QUICK, ACCTREC and GENEXP. Their signs are as hypothesized, except for ACCTREC. Of interest, each measure taps a different aspect of slack than the two measures significant in the previous correlation test. Using the "ease-of-recovery" idea, these four measures tend to reflect aspects of slack that are more readily available.

**INSERT TABLE 4**

Slack Change

Building on the notion of slack loss or gain, parametric measures of the change in slack from year 2 to year 1 prior to product introduction were calculated as follows:

$$\text{Slack change} = \ln(\text{Variable}_1/\text{Variable}_2)$$

These are log relative measures that provide a symmetric distribution for proportionate changes in either direction and in addition reduce the impact of extreme values. Values that are negative, zero and positive imply decrease, no change and increase, respectively. (A drawback of using the log change measures is that they are undefined when values of the argument are negative. This reduced sample size, particularly for the EQUITY variable. As an alternative a simple percentage change measure was also tested. This still reduced sample size, because measures with negative denominators have questionable meaning, but slightly less. Percentage change measures however can result in extreme values when denominators are small and are consequently less desirable. In any event, findings were similar for both log change and percentage change measures.)

Each slack change measure was correlated with price reduction slope. Results are in the "full" column of table 5. Eight of the twelve variables are now significant, so it appears that the degree to which slack is lost or gained is important. The significant variables come from all three slack categories so the full range of slack dimensions is apparently related to pricing strategy. All eight significant variables have the predicted signs, except ACCTREC.

**INSERT TABLE 5**

Controlling for Performance

In Singh's investigation of risk-taking discussed earlier, performance was positively associated with slack and slack positively associated with risk taking, but performance alone was negatively associated with risk taking. This suggest that additional insight might be gained by controlling for performance. An overall measure of firm performance, Return on Stockholders Equity (ROSE), was calculated for each firm in the year prior to product introduction. The correlation between ROSE and price reduction slope was -.28 ($p<.06$), which is consistent with the expected negative association between performance and risk taking. To control for ROSE, price reduction slopes were regressed on ROSE and then the residuals were individually correlated with the slack change variables. Results are in the "partial" column of table 5.

With this additional control, nine of the twelve slack change variables are significant. Each of these nine, except ACCTREC, has the predicted sign and each has a higher correlation than in the "full" correlation tests. Controlling for the interrelationships between performance, slack and risk taking apparently better isolates the association between slack and risk taking.

Note also that, except for LTDEBT, all twelve measures of slack were significant either in table 5, where the change in the slack was tested or in table 3, where the amount of slack was tested. The only two measures, INVENT and NCASSET, significant in table 3 are the same two that are insignificant in table 5. Perhaps some aspects of slack are best captured by the amount and others by the change over time.

## DISCUSSION

### Central Hypothesis

The overall findings from the study are consistent with the central hypothesis. Slack was associated with the adoption of the more risky penetration pricing strategy. This supports the conclusions of Singh (1983) that organizational slack and risk taking are related. There are two broad implications of the result. First it emphasizes the importance of organizational variables such as slack in risk-taking behavior. Traditional economic theories of risk taking typically emphasize the risk versus expected return aspects of decision alternatives and stress the trade-offs between the two. In theory, alternatives can be assessed in terms of risk and expected return and risk averse decision makers will accept a greater risk alternative only if there is a compensating greater expected return. Decision makers can be perceived as having an indifference curve which describes the tradeoffs they are willing to accept. The indifference curve is exogenous. The results here suggest that slack is a variable that influences how the risk/return trade-off may be made. Penetration is a higher risk pricing strategy, but also a potentially more rewarding one. The findings are consistent with greater slack causing a willingness to accept greater risk in expectation of potentially greater return. In short, slack may be an organizational variable that influences the shape of the indifference curve.

Second, the results reinforce the notion of slack as a variable having behavioral consequences for the firm. Risk taking is likely permitted because slack provides the source of resources to cushion or absorb failure. Among other effects, slack appears to encourage innovation (e.g, Rosner, 1965, 1968), promote research and development (Kay, 1979) and promote intra-organizational

political harmony (Bourgeois & Singh, 1982), as well as encourage risk taking. Given these various behavioral effects of slack, one might question the completeness of organizational theories that stress efficiency and consequently assume that slack is undesirable.

Performance and Risk Taking

While not of central interest to this study, the finding that adoption of the penetration strategy was inversely associated with organizational performance (ROSE) is also of note. This confirms the findings of others (Bowman 1980, 1982; Singh 1983; Treacy, 1980) that risk taking and performance may be negatively related, and is consistent with theories that see risk taking as dependent on the relationship between the level of actual performance and the satisficing level.

Slack Level vs Slack Change

The findings also have some implications regarding what aspect of slack appears to affect organizational behavior. Measures of the change in slack over time (table 5) were considerably better predictors of risk taking that were measures of the level of slack at a point in time (table 3). This finding is consistent with previous views (e.g, Bourgeois, 1981) that it is the change in slack that influences strategic behavior rather than the amount of slack. (It should be noted here again that the variables used to measure the amount of slack are only valid if certain assumptions hold. Thus the poor results found in table 3 could be due to poor measures. In any event, the findings still suggest that future researchers interested in testing the effects of slack might benefit from using measures of change.)

Slack Categories and Risk Taking

While the overall findings of this study are consistent with Singh (1982), the findings for individual measures are not. Singh tested for associations between risk taking and three measures of slack. He used one measure (QUICK) from the "available" slack category and two measures (WKCAP and GENEXP) from the "recoverable" slack category (Singh's labels for both the variables and categories were different). Similar to the results of this study, Singh found WKCAP and GENEXP to be associated with risk taking. QUICK, however, was not. He consequently concluded that recoverable slack motivated increased risk taking but available slack had no effect. He speculated that this may occur because liquid resources that have not been absorbed by organizational activities are outside the work flow of the organization and hence do not play the same buffering role (against the consequences of risk taking) as do resources that have already been absorbed into the workflow. In general his conclusion was that the ease-of-recovery of the slack resources made a difference in the influence of slack on risk taking.

The findings from this study do not support that conclusion. This study investigated a wider range of measures, within all three categories (available, recoverable, potential) of the Bourgeois and Singh framework. A glance at table 5 shows that measures all along the ease-of-recovery dimension were associated with risk taking. Of particular interest are the results for the three measures in the available category; each suggests a finding contrary to Singh. Unallocated resources may influence behavior and slack need not necessarily be absorbed into organizational activities to serve as a potential buffer and motivate risk taking. One might also conclude that slack resources need not even be under the organization's current control to exercise influence on behavior.

This is suggested by the significant results for measures in the potential slack category.

On The Dimensions Of Slack

Each of these conclusions concerning ease-of-recovery, however, rests on a simple assumption: that the slack measures within each of the three categories reflect separate and distinguishable aspects of the organization's condition. While the arguments underlying the three category ease-of-recovery framework are intuitively appealing the real issue is whether the measures from different categories are related or distinct. That is an empirical question.

A look at the correlation matrix for the slack change measures (table 6) indicates interrelationships among the variables. This is not entirely unexpected since year-to-year changes in a firm would likely be captured by various measures. Several correlations, however, are particularly high (above .60) and merit some attention. Exploring these correlations may indicated relationships between measures within or across categories and may lead to a reduced set of measures that adequately capture the dimensions of slack.

**INSERT TABLE 6**

First, the pairwise correlation between CURRDEBT and TOTDEBT is .98, thus changes in total liabilities are strongly driven by changes in current liabilities. CURRDEBT and TOTDEBT are also each negatively correlated with QUICK at about -.87. The common thread among these three measures is current liabilities. Second, QUICK and ACCTREC are strongly negatively related (-.73). (QUICK was consistently positively related to risk taking as hypothesized , while ACCTREC was consistently negatively related, contrary to hypothesis. This is not surprising given the strong negative correlation between the two slack change

measures.) The negative correlation between QUICK and ACCTREC may be caused by a temporary and, from the stand point of slack measurement, an unimportant fluctuation in the collection of receivables. As explained earlier, QUICK and ACCTREC along with INVENT were measures created by Bourgeois and Singh (1982) in an attempt to decompose the broader measure WKCAP. The high inverse correlation between QUICK and ACCTREC and the insignificance of INVENT suggest that decomposition may be misleading.

If one accepts (a) that CURRDEBT, TOTDEBT and QUICK are all driven by changes in current liabilities that are adequately captured by QUICK and (b) that recombining QUICK, ACCTREC and INVENT into a single slack change measure is appropriate, then WKCAP remains as a primary measure of interest. (WKCAP was significantly associated with pricing strategy as predicted.) Changes in working capital appear to represent one source of slack.

Next, note that PROFIT and INTCOV are highly related (.70). Again this is perhaps not surprising; changes in profits should lead to corresponding changes in the ability to service debt. (PROFIT and INTCOV were both significantly related to risk taking.) Profits then may represent a second primary source of slack.

Next, note that GENEXP has relatively low correlations with all other variables but was significantly related to pricing strategy. Resources tied up in period expenses may represent a third source of slack.

Lastly, recall that only INVENT and NCASSET were significant in the slack level tests presented in table 3. It has been argued above that INVENT should be subsumed by WKCAP. NCASSET remains. NCASSET is not in general highly correlated with the other measures. Resources tied up in plant and equipment may represent a fourth source of slack.

It is true that others looking at the correlation matrix may see other "stories" that explain the interrelationships among the measures. The above is offered as a plausible explanation. It is an attempt to summarize the various individual slack measures into a reduced set of factors.[6] While the three category framework provided by Bourgeois and Singh was useful in initially identifying potential sources of slack, the high interrelationships between some individual measures indicate that the three categories, while conceptually appealing, may not be empirically distinct.

Four sources of slack are tentatively suggested.

1. resources generated from increases in profits
2. resources tied up in excess working capital
3. resources absorbed as excess operating expenses
4. resources tied up in excess plant and equipment or productive capacity

Measures related to profits, working capital, operating expenses and non-current assets may adequately capture the dimensions of organizational slack that are reflected in publicly available accounting data.

While future studies need not limit themselves to the measures used in this paper, the four measures from this paper that appear important and distinct are PROFIT, WKCAP, GENEXP and NCASSET. Future research is perhaps necessary to establish whether these four measures (or closely related ones) are consistently distinct factors in other samples. However, studies of financial ratios (e.g, Chen & Shimerda, 1981) indicate that these four measures align well with distinct factors that have been shown to consistently exist in financial accounting data.

## CONCLUDING REMARKS

The broad conclusions of this study can be briefly summarized as follows.

(a) Increases in organizational slack appear to be followed by more risky decisions.

(b) Measures of the change in slack over time rather than the amount of slack at a point in time appear to be better indicators of risk taking behavior.

(c) Slack is a multi-dimensional construct. Measurement along four identified dimensions may be useful in reflecting the different aspects of slack in empirical studies.

These conclusions must be tempered by two limitations. First only one specific risk taking decision, product pricing strategy, was investigated. The choice of pricing strategy for the sample firms investigated was not a trivial one; the monetary value of the defense programs involved was large. Nonetheless, only one type of strategic decision was examined; additional research is required to explore the links between slack and other types of risky decisions.

Second, while financial accounting-based variables have been widely used in past research to measure slack, such measures are only proxies for the idea of "excess" resources implied by the slack concept. Conclusions should be interpreted with this in mind. Validation of accounting-based measure against alternative measures (perhaps developed via questionnaires or interviews of organizational members) would be a useful direction for future research.

## FOOTNOTES

1. See Womer (1979) for a discussion of learning curve theory. See Greer (1985) for an application of learning curves to pricing strategy.
2. For a discussion of the defense market see Olvey, Golden and Kelly (1984) or Gansler (1980).
3. Readers familiar with defense contracting may question the ability of manufacturers to exercise a pricing strategy. Prices are determined primarily by competitive bids and negotiation and prices are typically negotiated on a "cost plus" basis and determined by some agreed upon formula. Prices may seem to be a direct function of costs incurred, with little leeway allowed for contractor pricing discretion. However, discretion enters through the determination of "cost".

   In spite of regulation by the Cost Accounting Standards Board, substantial flexibility exists within allowable cost accounting procedures. The allowable procedures permit flexibility both in assigning costs to programs within a given period and in assigning costs across different periods. Accounting procedures that assign costs to different periods, in particular, allow the recognition of costs earlier or later and consequently provide a contractor with the flexibility to "cost justify" different pricing strategies (Greer & Liao, 1983, 1984). Earlier recognition of costs would be associated with a higher first unit price and steeper price reduction curve. Delaying cost recognition would permit a lower first unit price but

result in a flatter price reduction curve. Evidence (Greer, 1985) substantiates a strong relationship between accounting methods used by contractors and contractor pricing strategies. In short, while prices may be tied to costs incurred in the defense contracting market, firms have an ability to either skim or penetrate via the application of accounting methods.

4. For further discussion of factors that may influence pricing strategies, see Caferelli (1980), Dean (1969), James (1969), and Wasson (1974).

5. Both Bourgeios (1981) and Singh (1983) provide reviews of the slack literature and the varying definitions employed. Singh also reviews approaches to the measurement of slack.

6. A logical approach to examine the interrelationships among the variables is factor analysis. Factor analysis was conducted but not without problems. As previously indicated, the slack change measures are undefined when negative values are present, resulting in missing values. Different sample firms had missing values for different slack change measures such that only 15 firms had slack change measures available for all variables. Separate factor analyses were conducted on all the variables (for the 15 firms) and on various subsets of the variables (in an attempt to increase sample size above 15). Results were somewhat dependent on the variables included in the particular factor analysis. There was, however, no evidence to contradict the interpretation of interrelationships provided in the text.

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TABLE 1

Sample Projects

| Project | Company | Year | Slope |
|---|---|---|---|
| F-86D | North American | 51 | .926 |
| F-86F | North American | 51 | .870 |
| F-84F | Republic | 51 | .725 |
| F-100A/C | North American | 52 | .839 |
| F-1B/C/MF-1C | North American | 52 | .783 |
| F-102-A | General Dynamics | 53 | .724 |
| F 101-A/B/C | McDonnell Douglas | 54 | .802 |
| F-100D | North American | 54 | .934 |
| A-4B | McDonnell Douglas | 55 | .834 |
| B-52G | Boeing | 57 | .869 |
| F-106A/B | General Dynamics | 57 | .837 |
| A-4C | McDonnell Douglas | 57 | .894 |
| F-105B/D | Republic | 57 | .759 |
| F-4A/B | McDonnell Douglas | 59 | .834 |
| P-3A | Lockheed | 60 | .718 |
| A-6A | Gruman | 61 | .829 |
| RIM-24B | General Dynamics | 61 | .923 |
| A-4E | McDonnell Douglas | 61 | .892 |
| RIM-2E | General Dynamics | 61 | .930 |
| F-4D | McDonnell Douglas | 64 | .886 |
| A-7A/B | Vought | 65 | .852 |
| P-3B | Lockheed | 65 | .910 |
| RIM-66A | General Dynamics | 66 | .763 |
| RIM-67A | General Dynamics | 66 | .825 |
| AIM-7F | Raytheon | 68 | .773 |
| A-7D | Vought | 68 | .950 |
| S-3A | Lockheed | 72 | .846 |
| F-15A | McDonnell Douglas | 73 | .917 |
| AGM-78D | General Dynamics | 73 | 1.088 |
| AH-1S | Bell | 75 | .891 |
| AH-1T | Bell | 76 | 1.021 |
| F/A-18A | McDonnell Douglas | 79 | .860 |
| AIM-7M | Raytheon | 80 | .880 |
| BGM-109 | General Dynamics | 80 | .943 |

TABLE 2

Slack Measures

| SYMBOL | CALCULATION | ASSOCIATION WITH SLACK |
|---|---|---|
| AVAILABLE SLACK | | |
| PROFIT | Net Income/Sales | + |
| EQUITY | (Stock. Equity$_t$-Stock. Equity$_{t-1}$)/Sales | + |
| QUICK | (Cash + Mkt. Sec. - Curr. Liab.)/Sales | + |
| RECOVERABLE SLACK: | | |
| WKCAP | (Curr. Asset - Curr. Liab.)/Sales | + |
| ACCTREC | Accts. Rec. / Sales | + |
| INVENT | Inventory/Sales | + |
| GENEXP | (Sales - COGS - Net Income)/Sales | + |
| NCASSET | Non-Curr. Assets/Sales | + |
| POTENTIAL SLACK: | | |
| CURRDEBT | Curr. Liab./Stock. Equity | - |
| LTDEBT | Long Term Liab./Stock. Equity | - |
| TOTDEBT | Total Liab./Stock. Equity | - |
| INTCOV | (Net Income+Interest Exp.)/Interest Exp. | + |

TABLE 3

Correlation of Slack Measures with Price Reduction Slope

| MEASURE | n | PREDICTED SIGN | CORRELATION |
|---|---|---|---|
| AVAILIBLE SLACK: | | | |
| PROFIT | 34 | + | -.13 |
| EQUITY | 31 | + | .14 |
| QUICK | 34 | + | -.10 |
| RECOVERABLE SLACK: | | | |
| WKCAP | 34 | + | .18 |
| ACCTREC | 34 | + | -.13 |
| INVENT | 34 | + | .29** |
| GENEXP | 33 | + | .13 |
| NCASSET | 34 | + | .30** |
| POTENTIAL SLACK: | | | |
| CURRDEBT | 34 | - | -.18 |
| LTDEBT | 34 | - | .07 |
| TOTDEBT | 34 | - | -.05 |
| INTCOV | 31 | + | -.11 |

* $p < .10$
** $p < .05$

One tailed tests.

TABLE 4

T Test for Difference in Price Reduction Slope:
Slack Gainers vs Slack Losers

| MEASURE | SLACK GAIN SLOPE MEAN | n | SLACK LOSS SLOPE MEAN | n | Predicted Sign of t | t |
|---|---|---|---|---|---|---|
| AVAILABLE SLACK | | | | | | |
| PROFIT | .876 | 17 | .849 | 17 | + | .98 |
| EQUITY | .873 | 20 | .849 | 11 | + | .77 |
| QUICK | .882 | 18 | .840 | 16 | + | 1.56* |
| RECOVERABLE SLACK | | | | | | |
| WKCAP | .893 | 15 | .838 | 19 | + | 2.03** |
| ACCTREC | .835 | 16 | .887 | 18 | + | -1.96* |
| INVENT | .853 | 21 | .877 | 13 | + | -.72 |
| GENEXP | .905 | 13 | .837 | 20 | + | 2.48*** |
| NCASSET | .857 | 21 | .872 | 13 | + | -.52 |
| POTENTIAL SLACK | | | | | | |
| CURRDEBT | .880 | 16 | .847 | 18 | + | 1.16 |
| LTDEBT | .855 | 18 | .875 | 12 | + | -.66 |
| TOTDEBT | .881 | 15 | .848 | 19 | + | 1.11 |
| INTCOV | .881 | 17 | .847 | 14 | + | 1.16 |

* $p < .10$
** $p < .05$
*** $p < .01$
*** Significant at $< .01$

One tailed tests.

TABLE 5

Correlation of Slack Change with Price Reduction Slope

| MEASURE | n | PREDICTED SIGN | CORRELATION (FULL) | CORRELATION (PARTIAL) |
|---|---|---|---|---|
| AVAILABLE SLACK | | | | |
| PROFIT | 27 | + | .27* | .34** |
| EQUITY | 19 | + | .37* | .38* |
| QUICK | 31 | + | .29* | .33** |
| RECOVERABLE SLACK | | | | |
| WKCAP | 31 | + | .38** | .41** |
| ACCTREC | 31 | + | -.27* | -.31** |
| INVENT | 31 | + | .10 | .06 |
| GENEXP | 26 | + | .43** | .43** |
| NCASSET | 31 | + | -.04 | -.01 |
| POTENTIAL SLACK | | | | |
| CURRDEBT | 31 | - | -.42*** | -.48*** |
| LTDEBT | 27 | - | -.01 | -.09 |
| TOTDEBT | 31 | - | -.36** | -.42*** |
| INTCOV | 24 | + | .26 | .35** |

* $p < .10$
** $p < .05$
*** $p < .01$

One tailed tests.

TABLE 6
Correlations Between Slack Change Measures

| | EQUITY | QUICK | WKCAP | ACCTREC | INVENT | GENEXP | NCASSET | CURRDEBT | LIDEBT | TOIDEBT | INTCOV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PROFIT | .49 | .17 | .49 | -.22 | .52 | .28 | .11 | -.20 | -.12 | -.24 | .70 |
| EQUITY | | .13 | .22 | -.41 | .27 | .12 | .17 | -.19 | -.09 | -.08 | .20 |
| QUICK | | | .19 | -.73 | -.41 | .20 | -.28 | -.87 | -.15 | -.88 | .07 |
| WKCAP | | | | .12 | .43 | .45 | .25 | -.49 | -.20 | -.44 | .25 |
| ACCTREC | | | | | .29 | -.10 | .59 | .50 | .10 | .52 | -.19 |
| INVENT | | | | | | .11 | .35 | .31 | .08 | .31 | .47 |
| GENEXP | | | | | | | -.07 | -.25 | -.15 | -.20 | .21 |
| NCASSERT | | | | | | | | .08 | .04 | .13 | .04 |
| CURRDEBT | | | | | | | | | .30 | .98 | .01 |
| LIDEBT | | | | | | | | | | .46 | -.17 |
| TOIDEBT | | | | | | | | | | | -.06 |

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